

91.301, Organization of Programming Languages
Spring 2007, Prof. Yanco

Sample Quiz 1

Note that this exam is shorter than the actual exam will be. (Two questions from the full length exam were deleted, as we have not covered that material yet.) However, this sample exam will give you an idea as to what types of problems will be on the exam on Thursday, 28 September.

Problem 1

What is the result of the evaluation of the final statement in each of the following groups of Scheme expressions? Write “error” if an error would result or “procedure” if a procedure would be returned. Assume that each group is evaluated separately.

```
(define a 1)
(define b 3)
(define c 5)

(let ((a 2)
      (b (+ a 5))
      (c b))
  (+ a b c))
```

```
(define (map lst op)
  (if (null? lst)
      nil
      (cons (op (car lst))
            (map (cdr lst) op))))

(map (lambda (x) (if (even? x) 1 0))
     (list 2 3 4 5 6 7))
```

```
(define (my-func f)
  (lambda (x y) (f (f x y) (f x y))))

((my-func *) 2 3)
```

Problem 2

a. Define applicative order evaluation

b. Define normal order evaluation

c. Given the following code,

```
(define (add a b)
  (display " plus ")
  (+ a b))

(add (begin (display " one ")
            1)
     (begin (display " two ")
            2))
```

Which of the following could be printed in Scheme? In normal-order Scheme?

	Scheme	Normal-order Scheme
plus one two		
plus two one		
one plus two		
two plus one		
one two plus		
two one plus		

Problem 3

For the two expressions below, write the sequence of cars and cdrs needed to get the number 3 out of each list. You may find it helpful to draw the box-and-pointer diagrams, but you will not be graded on them.

```
(define first-list (cons 1 (cons 2 (list 3 4 5))))
```

```
(define second-list (list (cons 1 2) (cons 3 4) 5))
```

Problem 4

Write a procedure that takes two ordered lists (low to high) and returns a list of the merged elements with no duplicates. For example,

```
(merge '(1 3 5 6) '(2 4 6 8 10 12))
```

will return the list

```
(1 2 3 4 5 6 8 10 12)
```

While you can assume that the lists are ordered, do not assume that the lists are equal lengths.

What is the order of growth of the merge procedure in terms of time and space?

Time: _____

Space: _____

What variable in the function is n dependent upon?

Does merge generate a recursive or an iterative process? _____

Problem 5

Write a function `apply-twice` that takes a function `f` as its argument and returns a function that takes one argument as input and returns the value that one would obtain if `f` were applied twice to that argument.

For example,

```
((apply-twice square) 2)
```

would return

```
16
```

and

```
((apply-twice (lambda (x) (+ x 2))) 5)
```

would return

```
9
```

Problem 6

Despite the dot-com bust, Louis Reasoner has decided that he would like to create a web site to help people track their collections. The back end of the web site will be programmed in Scheme. First, we need to create a means for storing information about an item in a person's collection: each item record will contain the name of the item, its estimated value, and its condition.

We define the constructor `make-item` as follows:

```
(define (make-item item-name value condition)
  (list (cons item-name value) condition))
```

Write the selectors `item-name`, `item-value`, and `item-condition`.

To store all of the items in a person's collection we will use the following constructor:

```
(define make-collection-list list)
```

Write the selectors `first-item` and `rest-items`.

Problem 6 continued

Write a procedure called `total-value` which takes a collection-list and returns the total value of the collection. Be sure to use the constructors and selectors that you helped define on the previous page.

What is the order of growth of the `total-value` procedure in terms of time and space?

Time: _____

Space: _____

What variable in the function is n dependent upon?

Does `total-value` generate a recursive or an iterative process? _____

Problem 7

Given the following definition of `cons`, define `car` and `cdr`.

```
(define (cons x y)
  (lambda (m)
    (cond ((eq? m 'car) x)
          ((eq? m 'cdr) y)
          (else (error "Unknown message - CONS" m)))))
```